



# Engineering Education Capacities: How Engineering Ecosystems are Preparing Students in Africa for Employment

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Workshop held in Dar es Salaam on 1<sup>st</sup> – 2<sup>nd</sup> December 2021

Organized by STIPRO



# Dynamics of demand and supply of engineering professionals – making our engineers work for industrialization in Africa

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# Presentation layout

- ❑ Examples of Challenges of Africa – where engineering is required
- ❑ Demand and supply factors
- ❑ Some statistics on supply of engineers
- ❑ Why quantity and quality of engineers in SSA is low
- ❑ Conclusion
- ❑ Recommendations



# Examples of Challenges of Africa – require engineering solutions to tackle them

Urbanization,

Unemployment,

Food,

Water and energy security,

Environmental degradation,

Climate change,

Natural disasters and poverty

Inadequate provision of universal health coverage

Quality education,

Beneficiation from natural resources

Inadequate infrastructure,

Recognized need to create sustainable cities, etc

*UNESCO Engineering Report (2021)*



# Challenges of Africa – require engineering solutions to tackle them

Many African countries rely on extractive industries – exporting raw materials with minimum or no value addition

Large sections of the population depend on agriculture in informal settings.

Africa also relies heavily on imports of machinery, and its share of manufacturing as a proportion of GDP is substantially very low.

*UNESCO Engineering Report (2021)*



# Demand in economics terms

- Demand – the amount of good or service that a person or society will buy at a particular price at a particular time.
- Will depend on a number of factors including:
  - ❑ Population/ age distribution/ changes in population
  - ❑ Level of industrialization and new technologies
  - ❑ Per capita income and GDP for the country
  - ❑ Tastes and and change in peoples tests
  - ❑ Prices of competing or complementary services
  - ❑ Number of people/communities that require the services goods/services





# Supply in economics terms

- ▶ Supply - Amount of good or service that producers will put onto the market at any particular price.
- ▶ Will depend on factors including:
  - ❑ Unit costs of production. How much does it cost to produce engineers
  - ❑ Ecological factors in the production of engineers. The infrastructure, the industry participation, etc.
  - ❑ Advances in technology in altering production methods
  - ❑ Incentives in the production.
- ▶ Engineering is seen as a means to enhance economic growth



# What other factors affect demand and supply of engineers?

- ▶ The Demand pull or the Supply Push?
- ❑ Should countries first have engineers before they can take off to industrialization or they should first have a developed industrialized economy before they can train engineers?
- ❑ China took deliberate steps to train engineers even before they had where to work – from 1980s. On the other hand, USA had industries to work in and then trained to serve those industries.
- ❑ Many people think that Africa is the next continent to be the hub of production. It may not easilt be unless we develop the human resource capacity.





# Some other factors affecting demand and supply of engineers

- The poor ratio between engineers: technicians and artisans
- The foreign firms that come along with their staff. This leads to redundancy of the engineers but also lack of transfer of skills
- The barrier of mutual recognition between the engineers in different countries



# Supply of Engineering graduates in comparison with other economies

Country/area	Total Population	Number of graduate engineers produced per annum	Total number of graduate Engineers
China	1,418,100,000	1,300,000	28,000,000
India	1,398,790,980	1,000,000	22,000,000
Africa	1,384,928,927	100,000	1,500,000
Uganda	43,000,000	750	15,000
USA	333,691,290	240,000	4,000,000



# Demand for engineers in Africa

- ▶ The perceived low demand for engineers depends on assumption of maintenance of the status quo.
- ▶ If Africa is to be the centre of economic activity of the world in the near future, the numbers to train must be many more.
- ▶ Africa is vast, has a fast growing population , but exports most of the raw materials. When Africa industrializes, it will make engineers very active and productive
- ▶ In one sector of water alone, it is estimated that Africa requires 2.5 million engineers are required in Sub Sahara Africa.

Country	Qualified engineers per population
China	200
UK	311
Brazil	227
Uganda	30,000



# Policy issues on why quantity and quality of engineers in S S Africa is low

- Low levels of funding by Governments. Even the World Bank had advised that university funding is not a priority.
- Policy Makers do not have adequate understanding of problems of engineering, from training to requirements of practice in the field.
- Brain drain to other countries
- Reliance on foreign funding for higher education institutions in Sub Sahara Africa
- Lack of pupillage training scheme necessary for moulding fresh engineering graduates with work-based skills that lead to registration and early retention in the profession as is done in the other countries in the region



# Why is supply of engineers low?

- Pre University level constraints
  - Few students and teachers in STEM
  - Very few females doing STEM
  - Teaching that is not very practical oriented. Students do not see the immediate use of the knowledge at that level.
- University level constraints
  - Few universities that offer engineering
  - Limited infrastructure for engineering training: laboratories, etc
  - Students not introduced to industry practices early enough
  - Limited human resources (few lecturers and technicians; poor pay compared to industry counterparts)
  - Little interaction between academia and industry on setting the requirements to provide hands on training and to solve challenges in society
  - Lecturers lack industry experience.



# Why is supply of engineers low? (cont..)

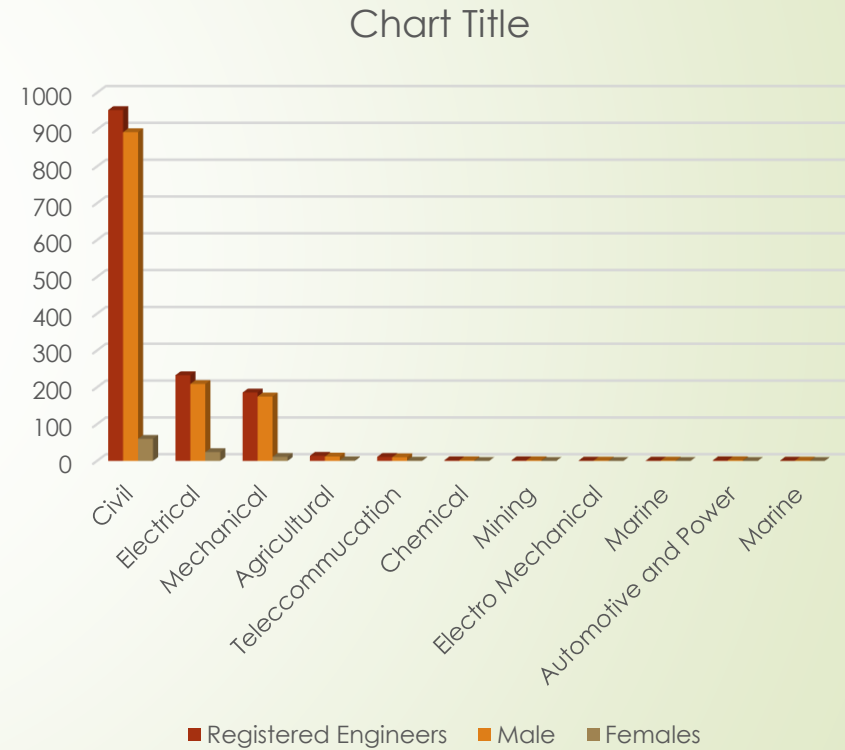
- ▶ Post graduate level
  - ▶ Limited enterprises that can absorb graduate engineers
  - ▶ Lack of a pupillage scheme to groom the graduates
  - ▶ Some engineers can not easily adopt.
  - ▶ Demand is for engineers who have experience and are registered and many are not yet at that level.
- ▶ Why many engineers are not registered?
  - ▶ A good number of engineers are involved in sales and marketing hence do not have the requirements. That makes them stunted.
  - ▶ Lack of a pupillage scheme
  - ▶ Lack of exposure to engineering projects and processes.
  - ▶ Inability to document the projects in a systematic way.





# Registered Engineers in Uganda

Specialization	Total	M	F
Civil	953	893	60
Electrical	233	209	24
Mechanical	186	175	11
Agricultural	14	12	2
Telecommunication	11	10	1
Chemical	2	2	0
Mining	2	2	0
Electro Mechanical	1	1	0
Marine	1	1	0
Automotive and Power	2	2	0
Marine	1	1	0
<b>TOTAL</b>	<b>1406</b>	<b>1308</b>	<b>98</b>





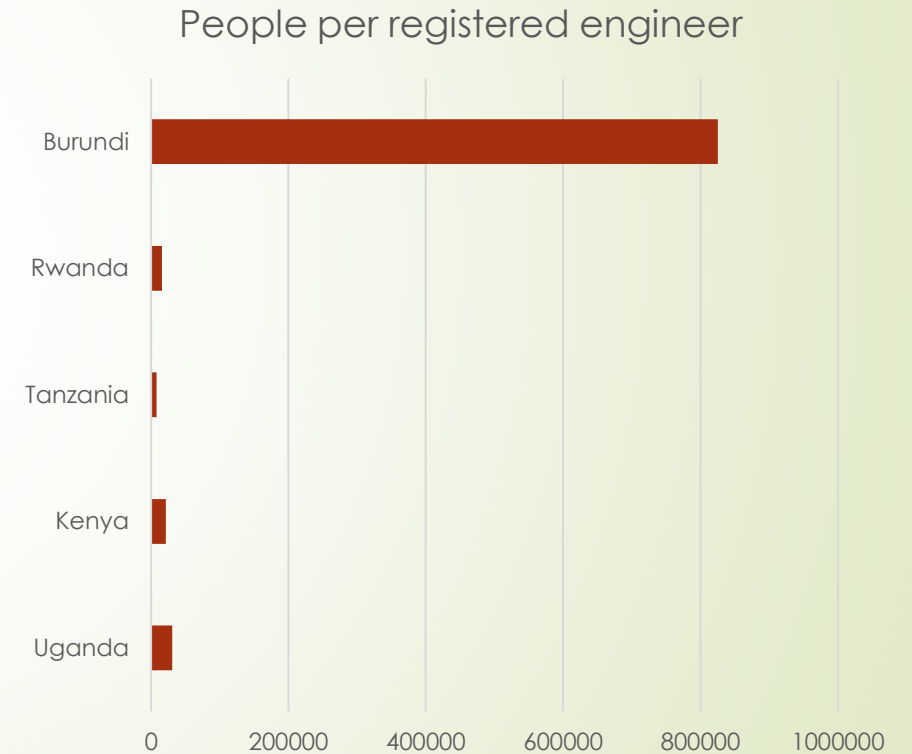
# Registered engineers in Uganda (Cont..)

- ▶ A number of specializations missing e.g. Aeronautical, bio medical engineering, etc.
- ▶ **Very few females registered**
- ▶ **Not ready for the Fourth Industrial Revolution: only one Electro-mechanical engineer**
- ▶ **Civil Engineers are the majority due to involvement in Civil Engineering infrastructure projects.**



# Registered Engineers in East Africa

	No. of registered engineers	Population	People per registered engineer
Uganda	1406	43000000	30714
Kenya	2586	55405672	21425
Tanzania	7610	62,080,012	8158
Rwanda	850	13,394,215	15758
Burundi	15	12,378,962	825264
Southern Sudan	??	11,375,047??	





# Conclusion

- The demand for producing engineers is there if Africa is to develop and industrialize.
- The supply of engineers is very low. For Africa to develop, we need many more engineers in different fields
- There are lapses in the quality of engineers produced due to inadequacies in the ecosystem. This can be improved upon if the Governments are committed just like China became,
- Alignment with global trends that include big data, AI, progress in communications and energy, robotics and additive manufacturing, as well as the urgent need to develop basic infrastructures, places a significant demand to train more engineers. We need African capacity to create solutions.



# Recommendations to increase demand and supply of engineers

- ▶ Have a minimum percentage for local engineers participating on projects even if the funding is from elsewhere.
- ▶ Have students to be placed in industry for a period of time apart from the short periods of industrial training.
- ▶ All graduate engineers to be attached on a project for pupillage and taken through in a structured manner. Pupillage training scheme necessary for moulding fresh engineering graduates with work-based skills that lead to registration and early retention in the profession.
- ▶ Need to carry out the demand for engineers analysis so that universities largely train strategically for the job market.
- ▶ Universities should allow the faculty to have industry experience and experienced people from the industry should be recruited at the university even if they do not have PhDs





# Recommendations to increase demand and supply (Cont..)

- Universities to provide a minimum percentage for females – e.g. Makerere University has adopted a minimum of 40% intake whether on Government or Private sponsorship on STEM
- Governments should prioritize provision of laboratory infrastructure for universities. Universities to be encouraged to share where possible.
- Career guidance should be emphasized at the Secondary School level.
- Need to give students employability skills such as communication skills, familiarity with industry processes and requirements through placements
- Curricula should be geared more Problem Based Learning to impart practical skills instead of chalk and talk. These add to the competences of engineering graduates.
- Linkages with industry to gain practical experience and for the industry to provide researchable topics that will help the student, the lecturers and the industry.





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# Ahsante

➤ Thank you

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